

# Switched Capacitor Voltage Converter

## FEATURES

- Plug-In Compatible with 7660 with These Additional Features:
  - *Guaranteed* Operation to 9V, with No External Diode, Over Full Temperature Range
  - Boost Pin (Pin 1) for Higher Switching Frequency
  - Lower Quiescent Power
  - Efficient Voltage Doubler
- 200 $\mu$ A *Max.* No Load Supply Current at 5V
- 97% *Min.* Open Circuit Voltage Conversion Efficiency
- 95% *Min.* Power Conversion Efficiency
- Wide Operating Supply Voltage Range, 1.5V to 9V
- Easy to Use
- Commercial Device *Guaranteed* Over  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  Temperature Range

## APPLICATIONS

- Conversion of +5V to  $\pm 5\text{V}$  Supplies
- Precise Voltage Division,  $V_{\text{OUT}} = V_{\text{IN}} / 2 \pm 20\text{ppm}$
- Voltage Multiplication,  $V_{\text{OUT}} = \pm nV_{\text{IN}}$
- Supply Splitter,  $V_{\text{OUT}} = \pm V_{\text{S}} / 2$

## DESCRIPTION

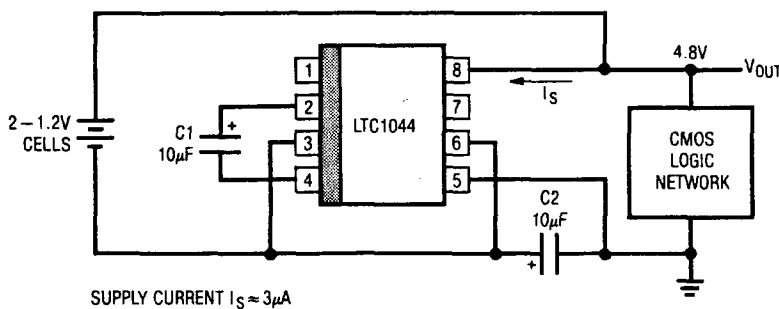
The LTC1044 is a monolithic CMOS switched capacitor voltage converter which is manufactured using Linear Technology's enhanced LTCMOS™ silicon gate process. The LTC1044 provides several voltage conversion functions: the input voltage can be inverted ( $V_{\text{OUT}} = -V_{\text{IN}}$ ), doubled ( $V_{\text{OUT}} = 2V_{\text{IN}}$ ), divided ( $V_{\text{OUT}} = V_{\text{IN}} / 2$ ) or multiplied ( $V_{\text{OUT}} = \pm nV_{\text{IN}}$ ).

Designed to be pin-for-pin and functionally compatible with the popular 7660, the LTC1044 provides significant features and improvements over earlier 7660 designs. These improvements include: full 1.5V to 9V supply operation over the entire operating temperature range, without the need for external protection diodes; 2½ times lower quiescent current for greater power conversion efficiency; and a "boost" function which is available to raise the internal oscillator frequency to optimize performance in specific applications.

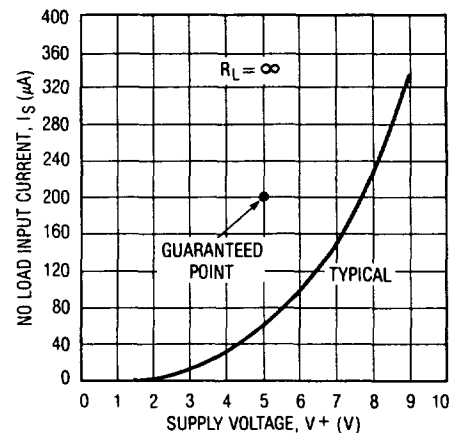
*Although the LTC1044 provides significant design and performance advantages over the earlier 7660 device, it still maintains its compatibility with existing 7660 designs.*

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**Generating CMOS Logic Supply from 2 Mercury Batteries**



**Supply Current vs Supply Voltage**



## ABSOLUTE MAXIMUM RATINGS

(Notes 1 and 2)

Supply Voltage	9.5V
Input Voltage on Pins 1, 6 and 7	
(Note 2)	$-0.3V \leq V_{IN} \leq V^+ + 0.3V$
Current into Pin 6	20 $\mu$ A
Output Short Circuit Duration	
( $V^+ \leq 5.5V$ )	Continuous
Operating Temperature Range	$-40^\circ C \leq T_A \leq 85^\circ C$
Storage Temperature Range	$-65^\circ C$ to $+150^\circ C$
Lead Temperature (Soldering, 10 sec.)	300 $^\circ C$

## PACKAGE/ORDER INFORMATION

<p>TOP VIEW</p> <p>S8 PACKAGE PLASTIC SO</p>	ORDER PART NUMBER
	LTC1044CS8
	PART MARKING
	1044

## ELECTRICAL CHARACTERISTICS $V^+ = 5V$ , $T_A = 25^\circ C$ , unless otherwise specified.

See LTC1044/7660 data sheet for test circuit.

SYMBOL	PARAMETER	CONDITIONS	LTC1044CS8			UNITS
			MIN	TYP	MAX	
$I_S$	Supply Current	$R_L = \infty$ , Pins 1 and 7 No Connection		60	200	$\mu$ A
		$R_L = \infty$ , Pins 1 and 7 $V = 3V$		20		$\mu$ A
$V^+_{L}$	Minimum Supply Voltage	$R_L = 10k$	●	1.5		V
$V^+_{H}$	Maximum Supply Voltage	$R_L = 10k$ (Note 3)	●		9	V
$R_{OUT}$	Output Resistance	$I_L = 200mA$ , $f_{OSC} = 5kHz$	●		100	$\Omega$
		$V^+ = 2V$ , $I_L = 3mA$ , $f_{OSC} = 1kHz$	●		130	$\Omega$
			●		325	$\Omega$
$f_{OSC}$	Oscillator Frequency	$C_{OSC} = 1pF$ (Note 4)	●	5		kHz
		$V^+ = 5V$	●	1		kHz
		$V^+ = 2V$	●			
$P_{EFF}$	Power Efficiency	$R_L = 5k\Omega$ , $f_{OSC} = 5kHz$		95	98	%
$V_{OUTEFF}$	Voltage Conversion Efficiency	$R_L = \infty$		97	99.9	%
$I_{OSC}$	Oscillator Sink or Source Current	$V_{OSC} = 0V$ or $V^+$	●		3	$\mu$ A
		Pin 1 = 0V Pin 1 = $V^+$	●		20	$\mu$ A

The ● denotes the specifications which apply over the full operating temperature range.

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

**Note 2:** Connecting any input terminal to voltages greater than  $V^+$  or less than ground may cause destructive latch-up. It is recommended that no inputs from sources operating from external supplies be applied prior to power-up of the LTC1044.

**Note 3:** The LTC1044 is guaranteed to operate with alkaline, mercury or NiCad 9V batteries, even though the initial battery voltage may be slightly higher than 9.0V.

**Note 4:**  $f_{OSC}$  is tested with  $C_{OSC} = 100pF$  to minimize the effects of test fixture capacitance loading. The 1pF frequency is correlated to this 100pF test point, and is intended to simulate the capacitance at pin 7 when the device is plugged into a test socket and no external capacitor is used.

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